EP241 Computer Programming

Topic 1

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Department of Electric and Electronics Engineering

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Content of Topic 1

- Introduction to course
- Introduction to Computers
- Introduction to Programming
Programming Languages

C++
Ruby
Python
JavaScript
C#
Matlab
C
PHP
Java
R
Introduction

- *Computer programming* is an essential part of the work of many scientists and engineers.

- **This semester we will teach C++ Programming Language**
  - C++ is used to write software where speed and flexibility is important
  - C++ is good at embedded systems or high-performance computing
  - C++ has has a lot of technical programming details
  - C++ is mostly prefered by engineers and young programmers!
<table>
<thead>
<tr>
<th>Rank</th>
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<tr>
<td>1.</td>
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<td>8.</td>
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<td>75.3</td>
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<td>10.</td>
<td>Matlab</td>
<td>72.4</td>
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Designed to allow the creation of programs that can run on different platforms with little or no modification, Java is a popular choice for Web applications.

C is used to write software where speed and flexibility is important, such as in embedded systems or high-performance computing.

Essentially a version of C with built-in support for "objects"—self-contained modules of code and data—C++ proved to be a natural fit for software driven by graphical user interfaces.

A scripting language that is often used by software developers to add programmability to their applications, such as engineering-analysis tools or animation software.

Created by Microsoft for developing software for the .NET framework, which supports many applications running on Windows.

Designed for programming statistical analysis and data-mining applications.

A scripting language primarily designed to support dynamic websites.

A scripting language used primarily to add functionality to Web browsers on the fly, allowing the creation of complex Web pages.
http://langpop.com
THE COURSE
Web Resources for the Course

- Course web page (for Exam questions and results)
  http://www.gantep.edu.tr/~bingul/ep241

- University of Gaziantep C++ resource page
  cpp.gantep.edu.tr
  - Tutorials, Sample Programs, Howtos

- C++ Resources Network:
  www.cplusplus.com

- C++ Reference:
  www.cppreference.com

- Türkçe ‘C Programlama Dili’ne Giriş’:
  www.gantep.edu.tr/~bingul/c

- Also search Google and Wikipedia for any of the expressions used in this course.
The Course Books

Programming with C++

*John R. Hubbard*

Schaum Outline Series (2000)

~ 15 $

C++ Demistified

*Jeff Kent*


~ 15 $
The Course Content

- Introduction to Programming and C++
- Structure and Basics of C++
- Control Structures: Selection & Loops
- Functions
- Arrays
- References & Pointers
- Dynamic Arrays and Vectors
- File Processing
- Basic Classes (and introduction to OOP)
- Processing
Lectures, Labs, Attendance, Exams

- **Mondays**
  
  *three-hour lecture*
  
  13:30-16:30

- **Fridays**
  
  *two-hour programming session in BIM labs*
  
  08:30-10:30

- **Attendance**
  
  You must attend at least 50% of the course

- **Exams**
  
  All *written exams*
  
  - Attendance 10%  Weakly
  - Quiz 20%  Weakly
  - Mid-term 30%
  - Final 40%
Grading

Independent from the arithmetic mean of the class, the following rules will be applied:

- 00 – 19  >>  FF
- 20 – 29  >>  FD
- 30 – 39  >>  DD
- 40 – 49  >>  DC
- 50 – 59  >>  CC
- 60 – 66  >>  CB
- 67 – 74  >>  BB
- 75 – 84  >>  BA
- 85 – 99  >>  AA
THE COMPUTER
The Computer


- A computer is a machine that manipulates data according to a set of instructions.

- First computers were developed in 1940–1945, they were very large in size.

- Modern computers are based on integrated circuits making them very fast and small in size.
The 5 MB Hard Disk of by IBM (1956)
the 10-Megabyte Computer System

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Microprocessor Transistor Counts 1971-2011 & Moore’s Law

The dashed line shows "Moore's Law": the number of transistors in a CPU doubling every two years.

Similar story for CPU power and storage units.
Parts of a Digital Computer

A computer can be divided into two main parts: *Hardware* and *Software*.

**Hardware** (=Donanım)


*Hardware* is the electronic and mechanical parts of the computer.

- *Storage Units*
- *Input Units*
- *Output Units*
- *Process Units*
A program is input from an HDD(1) and executed in RAM(2). Data is input from a keyboard(3) which is again stored in RAM(4). The CPU operates on the program and data in RAM(5) and outputs results to the HDD(6) as well as the monitor(7).

*This is all controlled by the CPU requiring only basic data flow instructions from the programmer.*
Parts of a Digital Computer

Software (=Yazılım)
See http://en.wikipedia.org/wiki/Software

Software consists of programs loaded from storage units. The programs execute on the computer hardware forming, for example,

- Operating System (OS)
- Compilers
- Application Programs
- …
Many programming languages require a compiler. A compiler translates the statements of program written in a high level language into a low level language (called the machine code).

Examples are:

- Fortran
- C
- C++
- Java
- Pascal
- Basic....
INTRODUCTION TO PROGRAMMING
Computer Programming

See http://en.wikipedia.org/wiki/Computer_programming

Computer programming (coding) is the process of

- writing,
- testing / debugging
- maintaining

the source code of computer programs.

The source code is written in a programming language, e.g.

```
// A simple C++ program
#include <iostream>

int main()
{
    cout << "Hello World!\n";
    return 0;
}
```
Generating an Executable File

- **Source code**: set of instructions written by the programmer (high level code) "hello.cpp"
- **Compiling phase**: Translates the source code into machine code (low level code)
  - The compiled code (low level code) "hello.obj" or "hello.o"
- **Linking phase**: Generates a machine code (executable code or executable program)
  - The executable program that you run under an operating system "hello.exe"
Problem Solving with Computers

Problem solving with computers involves several steps:

1. Clearly define the problem
2. Analyse the problem and formulate a method to solve it
3. Describe the solution in the form of an algorithm.
4. Draw a flowchart of the algorithm
5. Write the computer program
6. Compile and run the program (debugging)
7. Test the program (debugging)
8. Interpretation of results
Algorithms & Flow Charts

- **Algorithm**
gives a step-by-step description of the solution

1. Start
2. Input N
3. Set $M = 1$ and $F = 1$
4. Set $F = F \times M$
5. If $M = N$ GOTO S7
6. Set $M = M + 1$ and GOTO S4
7. Output $F$
8. End

- **Flow chart**
gives the logical flow of the solution in a diagrammatic form.
Beginning or end of an algorithm

Input or output of information

A computation

Decision making

The beginning of the repetition structure.

The direction of flow of the algorithm.

Circles with arrows connect the flowchart between pages.
Pro.gram.mer (noun)
An organism that converts caffeine into code.
FIRST C++ PROGRAM
What is C++?

See http://en.wikipedia.org/wiki/C++

- **C++** (pronounced "C plus plus")
  - is a general-purpose and middle-level programming language
  - is an enhancement to C
  - was developed by Danish computer scientist **Bjarne Stroustrup** in 1979 (called C with Classes) at Bell Labs (named C++ in 1983)
C++ Standards

- C++ is standardized by an ISO working group known as JTC1 / SC22/WG21.


<table>
<thead>
<tr>
<th>Year</th>
<th>C++ Standard</th>
<th>Informal name</th>
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<tbody>
<tr>
<td>2003</td>
<td>ISO/IEC 14882:2003</td>
<td>C++03</td>
</tr>
<tr>
<td>2014</td>
<td>ISO/IEC 14882:2014</td>
<td>C++14</td>
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<tr>
<td>2017</td>
<td>to be determined</td>
<td>C++17</td>
</tr>
<tr>
<td>2020</td>
<td>to be determined</td>
<td>C++20</td>
</tr>
</tbody>
</table>
A First C++ Program

// First C++ program
#include <iostream>
using namespace std;

int main()
{
    cout << "Hello World!";
    return 0;
}

Program source file name: hello.cpp

In general, C++ files have extensions:
.cpp, .c++, .cxx, .cc
Line 1: Lines starting with // are considered as comment.

Line 2: Lines starting with # are directives for preprocessor
#include <iostream> tells the compiler to include the
iostream file containing declarations of basic input output.

Line 3: All elements (variables, objects, ...) of C++ library declared
in std namespace. cout is the part of std namespace.

Line 4: An empty line does nothing but helps readability.

Line 5: Actual program, program starts with main() function.
Each C++ program must have only one main() function.
The beginning and end of the main() block is indicated by braces { }.

Line 7: Outputs “Hello World” to the user screen.

Line 9: return statement terminates the function (here main program).
return 0 sends a message to OS: “program ends without an error”
Compile and Run

We will use Dev-C++ compiler

Our Second C++ Program

// Calculates the sum of two integers
#include <iostream>
using namespace std;

int main() {
    int a, b, total;
    cout << "Enter two integers: ";
    cin >> a >> b;
    total = a + b;
    cout << "The sum is " << total << endl;
    return 0;
}
Standard Input and Output (I/O)

- The standard C++ library includes the header file `iostream`, where the input and output stream objects are declared.

  - `cout` to output data to the `screen`
  - `cin` to input data from the `keyboard`.

__This specific file (`iostream`) can be found usually under the folder:__

- for Linux (GCC)  
  `/usr/include/`
- for Windows (Dev-C++)  
  `C:\Dev-Cpp\include\`
Standard Input and Output (I/O)

- **Basic Output**
  
  ```cpp
  cout << "Hello World!";
  Outputs: Hello World!
  cout << "Hello " << "World!";
  Outputs: Hello World!
  cout << 1453;
  Outputs the number: 1453
  cout << x;
  Outputs the content of: x
  ```

- **Line break on output**
  
  ```cpp
  cout << "University of ";
  outputs:
  University of Gaziantep
  
  cout << "Gaziantep";
  University of Gaziantep
  
  cout << "University of\n ";
  University of
  cout << "Gaziantep";
  Gaziantep
  
  cout << "University of " << endl;
  University of
  cout << "Gaziantep";
  Gaziantep
  ```
Standard Input and Output (I/O)

- **Basic Input**

  ```
  cin >> a;  // reads a variable from keyboard to a variable a  
  cin >> a >> b;  // reads variables from keyboard to a and b  
  ```

```cpp
#include <iostream>  
using namespace std;

int main()
{
  int a, b, p;
  cout << "Enter two integers: ";
  cin >> a >> b;
  cout << "The product is " << a*b << endl;
}
```

// Calculates the product of two integers
If you remove the line “using namespace std;” then the source code on the previous pages needs modifying as follows:

```cpp
#include <iostream>

int main()
{
    int a, b, p;
    std::cout << "Enter two integers: ";
    std::cin >> a >> b;
    std::cout << "The product is " << a*b << std::endl;
}
```

// Calculates the product of two integers
Exercises

1. What is a compiler?
2. What is the difference between the compiler and the preprocessor?
3. Why is the function main() special?
4. What are the two types of comments, and how do they differ?
5. Write the smallest program that can be compiled, linked, and run.

6. Why does the following program fail?
   ```
   #include <iostream>
   using namespace std;
   int main() {
       cout << Is there a bug here?";
   }
   ```

7. Explain why we use std:: in the following program. What is the the output of program?
   ```
   #include <iostream>
   int main() {
       std::cout << " # # # " << std::endl;
       std::cout << "# ### ###" << std::endl;
       std::cout << " # # # " << std::endl;
       return 0;
   }
   ```

8. Write a program to input radius (an integer) of a sphere from keyboard and output its surface area and volume to the screen.